Claims

1. A resistance-changing function body comprising:

an object made of a first substance and interposed between a first electrode and a second electrode; and

a plurality of particles made of a second substance and arranged within the object so that an electrical resistance between the first electrode and the second electrode is changed before and after application of a specified voltage to between the first electrode and the second electrode, wherein

the first substance makes an electrical barrier against the second substance.

2. The resistance-changing function body as claimed in Claim 1, wherein

the object made of the first substance is an insulator, and

the particles made of the second substance are electrically conductive particles.

3. The resistance-changing function body as claimed in Claim 2, wherein

the conductive particles include those having particle sizes not less than 0.2 nm and less than 4nm.

4. A memory having the resistance-changing function body as defined in Claim 1, wherein

a rectifying function body having a rectification effect is electrically connected in series with the resistance-changing function body so as to determine a direction of a current that flows through the resistance-changing function body.

5. A memory having the resistance-changing function body as defined in Claim 1, wherein

a select transistor for selecting the resistance-changing function body is electrically connected in series with the resistance-changing function body.

6. A memory comprising at least two memory cells including the resistance-changing function body as defined in Claim 1, wherein

the objects made of the first substance in the two memory cells are integrally continuously formed, and

of the two memory cells, one electrode of one memory cell and one electrode of the other memory cell are electrically connected to each other, and the other electrode of the one memory cell and the other electrode of the other memory cell are electrically isolated from each other.

7. A memory comprising at least five memory cells including the resistance-changing function body as defined in Claim 1, a select transistor for selecting the resistance-changing function body and a rectifying function

body for determining a direction of a current that flows through the resistance-changing function body, wherein

each of the memory cells is connected between a bit line and a source line extended in a direction of column, and the select transistor of each of the memory cells is controlled by a word line extended in a direction of row,

second and fourth cells are arranged mutually adjacently in the direction of row, and third and fifth cells are arranged mutually adjacently in the direction of column, with respect to a first cell of the five memory cells,

the first cell and the second cell have a shared bit line, a shared word line and unshared source lines,

the first cell and the third cell have a shared bit line, a shared source line and unshared word lines,

the first cell and the fourth cell have a shared source line, a shared word line and unshared bit lines, and

the first cell and the fifth cell have a shared word line, a source line of the first cell and a bit line of the fifth cell are shared, and a bit line of the first cell and a source line of the fifth cell are shared.

8. A memory in which:

at least two memory cells including the resistance-changing function body as defined in Claim 1 are arranged in a direction parallel to a substrate; and

the objects made of the first substance of memory cells mutually adjacent in the direction parallel to the substrate are integrally continuously formed.

9. A memory in which:

at least two memory cells including the resistance-changing function body as defined in Claim 1 and a rectifying function body for determining a direction of a current that flows through the resistance-changing function body are arranged in a direction parallel to a substrate, and

the objects made of the first substance and/or the rectifying function bodies of memory cells mutually adjacent in the direction parallel to the substrate are integrally continuously formed.

10. The resistance-changing function body as claimed in Claim 1, wherein

a third electrode which allows a voltage to be applied to the object made of the first substance in a direction substantially perpendicular to a direction in which the first electrode and the second electrode are opposed to each other is adjacent to the object made of the first substance.

11. The resistance-changing function body as claimed in Claim 1, wherein

its electrical characteristics vary depending on whether the voltage applied to the third electrode is positive or negative.

12. The resistance-changing function body as claimed in Claim 1, wherein

the plurality of particles include at least two kinds of particles, which are a relatively small particle and a relatively large particle.

13. The resistance-changing function body as claimed in Claim 10, wherein

the particles are distributed uniformly with respect to a layer direction substantially parallel to the direction in which the first electrode and the second electrode are interconnected, and moreover the particles are distributed within a certain range with respect to a thickness direction perpendicular to the layer direction.

14. The resistance-changing function body as claimed in Claim 13, wherein

concentration of an element constituting the particles is maximized in one position within the distribution and reduced away from the position in the thickness directions.

15. The resistance-changing function body as claimed in Claim 13, wherein

density of the particles is maximized in one position within the distribution and reduced away from the position in the thickness directions.

16. The resistance-changing function body as claimed in Claim 13, wherein

particle size of the particles is maximized in one position within the distribution and reduced away from the position in the thickness directions.

17. The resistance-changing function body as claimed in Claim 13, wherein

the particles include at least two kinds of particles, which are a relatively small particle and a relatively large particle, and

an angle at which a straight line interconnecting the two particles intersects with a plane extending along the layer direction is not less than 45 degrees.

18. The resistance-changing function body as claimed in Claim 16, wherein

the distribution of particle sizes of the particles is asymmetrical between both sides of the position at which the particle size is maximized with respect to the thickness direction.

19. The resistance-changing function body as claimed in Claim 13, wherein

the object made of the first substance is an insulator, and

film thickness of the insulator in the thickness direction is not less than 2 nm and less than 50 nm.

20. A memory having the resistance-changing function body as defined in Claim 10, wherein

the first electrode and the second electrode are diffusion regions, respectively, formed on a surface of a semiconductor substrate,

the object made of the first substance is formed in a region located between the diffusion regions within the surface of the semiconductor substrate, and

the third electrode is provided on the object made of the first substance.

21. A memory having the resistance-changing function body as defined in Claim 10, wherein

the first electrode and the second electrode are conductors, respectively, formed on a substrate,

the object made of the first substance is formed in a region interposed between the conductors, and

the third electrode is provided on the insulator.

22. The resistance-changing function body as claimed in Claim 10, wherein

a fourth electrode is provided at a position confronting the third electrode with the object made of the first substance interposed therebetween,

the plurality of particles are so arranged that an electrical resistance between the first electrode and the second electrode is changed before and after application of a specified voltage to between the third electrode and the fourth electrode.

23. A memory in which at least two resistance-changing function bodies as defined in Claim 22 are stacked in a direction perpendicular to the substrate.

24. A method for manufacturing the resistance-changing function body as defined in Claim 2, comprising a step of implanting the second substance for forming the particles into the object made of the first substance by a negative ion implantation method.

25. The method for manufacturing the resistance-changing function body as claimed in Claim 24, comprising a step of carrying out hydrogen sintering after the negative ion implantation ends.

26. The method for manufacturing the resistance-changing function body claimed in Claim 24, comprising a step of carrying out heat treatment at a temperature of not lower than 500°C after the negative ion implantation ends.

27. A memory having the resistance-changing function body as defined in Claim 1.

28. A circuit having the memory as defined in Claim 26.

29. Electronic equipment having the circuit as defined in Claim 27.

30. A resistance-changing function body comprising:

a medium made of a first material and formed between a first conductor and a second conductor; and

at least one conductive particle which is formed within the medium and which is covered with a second material and made of a third material, wherein

the second material is a material serving as a barrier against passage of electric charges therethrough, and

the third material is a material having a function of retaining electric charges.

31. The resistance-changing function body as claimed in Claim 30, wherein

the second material is obtained by compositionally changing or chemically modifying the third material.

32. The resistance-changing function body as claimed in Claim 30, wherein

the second material is obtained by oxidizing or nitriding the third material.